In the Mood: Engaging Teenagers in Psychotherapy Using Mobile Phones

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ABSTRACT
Mental illness is a significant and growing problem throughout the world. Many mental health problems have their root in childhood, and early intervention is recommended. Engaging young people in psychotherapeutic activities is challenging, and treatment adherence is often poor. This paper presents a series of studies carried out as part of the development of a mobile and online symptom tracking tool for adolescents with mental health problems. Teenagers use the system to record symptoms on their mobile phones and can view this information in a clinical setting with a therapist. We focus on a clinical pilot of the system with ten users in public mental health clinics. As well as indicating that the mobile diary tool can increase client adherence to therapeutic activities, the study yields insight into the factors influencing the success of the design and informs the design of other systems to be used as adjuncts to therapy.

Author Keywords
Mental health, mobile applications, clinical evaluation.

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces – Evaluation / Methodology, Prototyping, User-Centred Design

K.4 COMPUTERS AND SOCIETY - K.4.2 Social Issues

General Terms: Design

INTRODUCTION
Mental illness is one of the most pressing concerns for public healthcare systems worldwide [30]. It is the leading cause of disability in the United States and Canada [30], and it is estimated that 1 in 4 individuals suffer from a diagnosable mental disorder each year [14]. The economic and social costs of mental illness are also high, with an estimated cost to UK employers of £28.3 billion per year [14]. In the US, mental disorders are in the top 5 conditions for direct medical expenditure [27].

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While early intervention is recommended, mental health professionals often experience difficulties engaging adolescent clients (young people receiving treatment) in therapeutic activities [24]. This is especially the case for 'homework' activities to be completed between therapy sessions. These tasks may require clients to prepare materials in advance of sessions or to record their symptoms between them. Typically these activities have a very low rate of completion. We propose that adherence can be improved through the use of materials which are engaging to adolescents and by providing tools that are relevant, familiar and readily-accessible to them. The contribution of this paper is in identifying and addressing the factors influencing the use and success of mobile technology for teenagers attending clinical therapy.

Mood Charting
Mood charting – also known as "symptom charting" or "mood monitoring" involves tracking clients' symptoms, behaviours and feelings on a regular basis. It is an important component of Cognitive Behavioural Therapy (CBT) and is used in therapeutic treatments for a wide range of complaints, including depression, bipolar disorder, attention deficit hyperactive disorder (ADHD), obsessive compulsive disorder (OCD) and non-verbal learning disorder [3]. Mood charting involves clients recording their moods at regular intervals to help identify contributing factors to their emotional state and behaviours. Several studies have found that regular and reliable client self-charting has a positive effect on therapeutic outcomes [4, 16]. Charted information can be used to identify triggers of moods and help develop coping strategies. It can also help identify the effects of changes in treatment (e.g. medication) and may help clients develop greater self-awareness, leading to subsequent control and understanding of their behaviour. By gathering therapeutic information between sessions, mood charting can save clinical time.

Motivation
Mood charting is predominantly a paper and pencil exercise which the client is asked to complete on a daily basis. Young people are notoriously poor at completing these charts or remembering to bring them to the next session. Identified limitations to paper-charting include: low adherence rates [11, 28], unreliable retrospective completion of diaries [28] and time intensive data entry

[28]. In a study using paper diaries with adults it was found that while the reported adherence rate was 90%, the actual rate was 11% [28]. In addition, this method provides little privacy or security to participants and may not be available when it is needed.

Given these problems, allowing clients to chart via mobile phone might increase adherence. The widespread and continuous availability of the mobile phone provides a significant advantage over existing methods, including electronic tools like ChronoRecord [3], a computer-based tool for symptom tracking for individuals with bipolar disorder. The mobile phone is available to most adolescents at almost any time and any place, and across socio-economic groups. It is a personal device, and using it in public is a common and accepted activity. These factors could help provide sufficient privacy to support sensitive therapeutic activities.

This paper investigates the issues surrounding the use of mobile phones for mood charting to increase adolescent engagement. A new system, Mobile Mood Diary (*MMD*), was developed to encourage adolescents to record their symptoms as part of their treatment. We describe a series of studies carried out during the development of the system, but focus in this paper on the results of a clinical pilot study. If monitoring mood by mobile phone is effective, it will have the potential for widespread application in therapy, and will help improve our understanding of how this ubiquitous and increasingly powerful technology can support therapeutic goals and mental rehabilitation.

RELATED RESEARCH

There has been little research into the use of the mobile phone as a platform for client work between clinical sessions. Research to date has either focused to a large degree on a limited use of the mobile phone, with particular emphasis on the use of SMS (see for e.g.[3]), or has not been conducted in clinical settings with young people.

Mobile Technology in Mental Health Interventions

A number of studies have investigated the therapeutic uses of mobile phones; one early study examined the use of SMS in the aftercare of adult bulimia nervosa patients [5]. It involved patients sending weekly messages to the hospital and receiving feedback. While initial evaluations were positive, a follow-up study in the UK found a much lower response rate [26]. Some patients found the program "too formal" and "computerized" and the content "patronizing" and "impersonal", and the study illustrates the need to be careful with automated responses.

Preziosa et al. have made the case for more extensive use of mobile phones as an extension to therapy [25]. They present two initial studies using mobile phones firstly as part of a program to tackle exam anxiety and secondly as a multimedia relaxation program for use by commuters on a train. Bang et al. implemented a mobile phone version of a commonly used CBT diary in a non-clinical setting [2]. The diary can be used to record negative situations as they arise and related emotions and thoughts. The phone could be used to photograph places where participants feel uncomfortable, rate their level of discomfort (1-100 Beck scale) and annotate these pictures with text, audio or video.

Mobile Technology to Support Behaviour Change

In the past few years there has been an increasingly wide range of research on using mobile applications to encourage general mental and physical wellbeing. These tools are typically standalone self-management tools for non-clinical use, and address issues such as awareness of diet [29], encouraging physical activity [8], and environmental awareness [12]. Some of these tools touch on mental wellness. The Wellness Diary is a CBT-based self-monitoring tool for personal wellness management. It runs on Nokia S60 mobile phones and was designed to both record and display graphs of user-recorded information. In two non-clinical studies, one for weight management and the other general wellness management, they found that it supported consistent use over several weeks [19]. A key element in sustained use was momentary access made possible by mobile phones. The authors speculated that reducing the complexity of the diary could increase adherence. The role of experience sampling in increasing self-awareness is explored by Morris et al. in a 1-month study with 8 adults suffering from stress, using a smartphone CBT diary with therapeutic activities [22]. As well as providing case studies illustrating the value of self-reflection, the study shows the potential of directly combining self recording with a technology intervention.

Recent work on persuasive technology has drawn on theories of behaviour change from psychology including the transtheoretical model. Design strategies have been suggested for mobile technologies to support long-term behaviour change [10]. These include: making the system available when and where the user needs it, not drawing attention to the user, making the system aesthetically appealing and comfortable to the user, and giving the user control over who has access to their data.

Design Approaches in Sensitive Areas

Access to adolescent mental health settings by non-clinical staff is generally extremely limited. In similar situations where access to end users is problematic or users are only able to provide limited input, researchers have relied on clinicians and stakeholders [21, 7]. A difficulty with this approach in adolescent mental health is the large difference in age and computer ability between clients and therapists. Allen et al. used a 3-stage development process for Phototalk, a tool to support face-to-face communication for individuals with Aphasia [1]. The first part involved a phase of participatory design with therapists, then an informal usability evaluation with 5 participants with aphasia followed by a one month field evaluation with 2

aphasic participants. Moffatt et al. also used non-aphasic participants to identify general usability problems, allowing them to focus on more disability specific issues when evaluating with aphasic users [21].

DEVELOPMENT OF THE MOBILE MOOD DIARY

The Mobile Mood Diary (*MMD*) system was designed by an interdisciplinary team including 2 HCI researchers and 1 therapist. Other therapists with a range of theoretical backgrounds were consulted at various stages to provide a broader perspective on the clinical suitability and theoretical foundation of the system.

Initial User Consultations

Certain groups of children and adolescents are at greater risk of suffering mental health problems. There is a higher prevalence of mental health problems among children from deprived backgrounds. As part of this research, we conducted a small survey of young people in an inner city school (n=20; 9 male and 11 female participants with mean age=13.6 sd=.68). 19 of these students owned a mobile phone. When asked how often they carried their phone with them, 13 respondents reported "always", 5 respondents "very often" and 2 "rarely" (mean=5.35, where 1 = "never", 2 = "rarely", 5= "very often" and 6 = "always").

When asked which method they would prefer for recording moods, 17 participants selected the mobile phone and 3 the paper method ("*I personally prefer paper, but I know the majority of people my age would find it more convenient to use mobiles*."). This indicates it would be important to provide alternatives for individuals who either do not own a phone or would prefer not to use one for this type of activity. Reasons for favouring the mobile phone related to privacy (*"It would be easy to do it without anybody knowing it"*), convenience (*"it would be easier to just write it into your phone than having to carry a piece of paper and pen around"*), and preference ("*the mobile is a young person's favourite piece of technology, so its closer to the heart than a paper diary*").

As well as working directly with therapists, we conducted in-situ interviews with 8 mental health professionals in the public service. To identify broader attitudes and concerns to technological interventions we conducted two therapist surveys. The first, a postal survey (n=32), focused on therapists' experience and attitudes toward technology. This survey revealed that technology has had a minimal impact on professional mental health services; many therapists were already using computers in their practice for administrative work, but only a small number were using computers with their clients. The second survey (n=28) conducted at a therapist conference focused on therapists' attitudes to and experience of mobile technology. A concern expressed by several therapists related to "*how to set boundaries*" with clients between sessions to avoid generating an expectation that therapists would continuously monitor client mood data. Associated with this were concerns about increasing workload between sessions and a loss of personal privacy.

A significant concern was around the "*danger of someone else accessing confidential information*". Other concerns related to the potential costs, the need for training and the possibility that the technology could be intrusive for people with certain types of disorder. There were positive but somewhat tentative responses from most therapists toward using mobile phones as an adjunct to therapy typified by the following comment from one therapist:

"It could improve engagement away from therapy. The young person could be enabled to take more control of their therapy. Teenagers probably prefer - less face to face - and just short bits of information. As a practitioner I need more training on working this technology."

Design Considerations

In exploring the use of a mobile diary system in a real-world setting, targeting current, commonly available phones avoids a situation where participants need to carry two devices for the duration of a study. As well as being inconvenient, this could draw unwanted attention (as could giving them a new and unusual device), and also detract from the personal nature of using your own phone. The price paid for this is the comparatively limited functionality of basic models at the time of this study, and the logistical issues surrounding the deployment of JavaME applications (the available technology platform).

There are many examples of SMS being used effectively in health including asthma support [13], nicotine addiction in young people [23] and diabetes [15]. We felt that the use of SMS would not provide sufficient privacy to a young person, as anyone could view received and sent messages. Perhaps more importantly the use of a standalone program makes it possible to develop a more interactive system, and to provide clients with a history of their previous moods, all important factors for encouraging long term use [10].

Many parents complete complex charts for their children; these charts often involve multiple daily readings and numerous measures. It was felt that too much complexity would result in lower adherence rates, because it would increase the amount of time required to make an entry and potentially make the task unsuited to mobile phones. In order to maximize adherence, it has been recommended to keep diaries short and to require less than a few minutes to complete [6, 19]. Our aim was to provide a method that was as straightforward to use as a paper diary, could be completed in a short amount of time and provided sufficient privacy and security.

Implementation

The system was implemented as a JavaME application which the client downloads to their phone. The client records mood, energy, and sleep, and a freeform text diary entry, in a step-by-step fashion (**Figure 1**).

They are then asked whether they wish to upload the data to the server. An online tool allows clients to visualize their recorded moods (**Figure 2**). These graphs display energy and mood entries on a scale of 1-10 and sleep on a 1-18 hour scale (with half an hour increments). The online interface also allows personal SMS reminders to be configured. Clients can also record moods online. This facilitates flexibility of use and supports clients who may prefer to use the online version, do not have suitable phones or who live in remote areas with poor mobile network coverage. The concern expressed by therapists around expectations that they would continuously monitor clients' entries was addressed with a protocol whereby only the client had access details to the website, and would log on to the system at the beginning of the session.

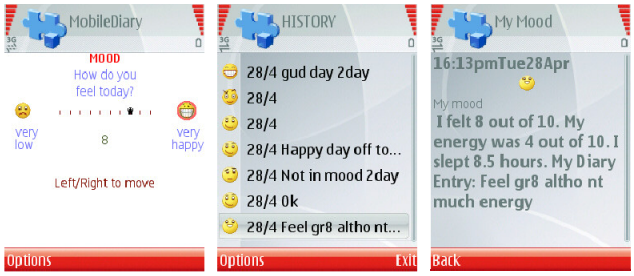

Figure 1 Mobile screenshots

PEER USER EVALUATIONS OF *MMD*

Consolvo et al. have argued that ubicomp technologies for behaviour change need to be evaluated in the field, in realistic situations where the user is following their normal routine [9]. This is equally true for mental health systems that are developed for use in clients' daily lives.

While therapists provided a valuable perspective on the clinical usefulness of *MMD*, it was important to investigate the usability and appeal of the system to young people before entering a clinical evaluation. Few therapists use technology as part of the way they deliver treatment, and very few will have had training on the use of technology to support interventions. To get a young person's perspective on the application, we used a peer user evaluation approach involving formative trials with young people from similar backgrounds to our target end-users, but without diagnosed mental health problems.

First Peer User Trial

Early-stage testing took place with six 12 to 14 year olds in an inner-city youth computer club and was in line with the technology-based activities carried out there. These adolescents did not have any identified mental health problems but had similar socio-economic, educational and geographical backgrounds to the targeted end-users. Participants were informed that the aim of their participation was to help people who can feel down or depressed and that their contributions and feedback could help improve the tool for these people. The designer spent between 15-20 minutes with each participant. This allowed time for each participant to use two versions of the *MMD*. For each version, the designer began by providing participants with instructions on how to download the *MMD*. Participants were then asked to install the application on their own phones, to complete initial registration and then to record one mood entry.

Significant usability issues with both prototypes were identified. On one version, the mood, energy and sleep scales were all on the one mobile screen. On some handsets this required vertical scrolling to navigate the content. The second prototype used four distinct screens for each element to be recorded. Each participant managed to complete the tasks with both versions, but on the one screen version some participants failed to notice some screen elements and became frustrated with navigating between different elements on the same screen. As a result the prototype with four distinct pages was considered the most effective. Additionally, some participants felt that the emoticons used to depict mood were not accurate representations. As a result, it was decided to modify the emoticons and to anchor the emoticons with explanatory words.

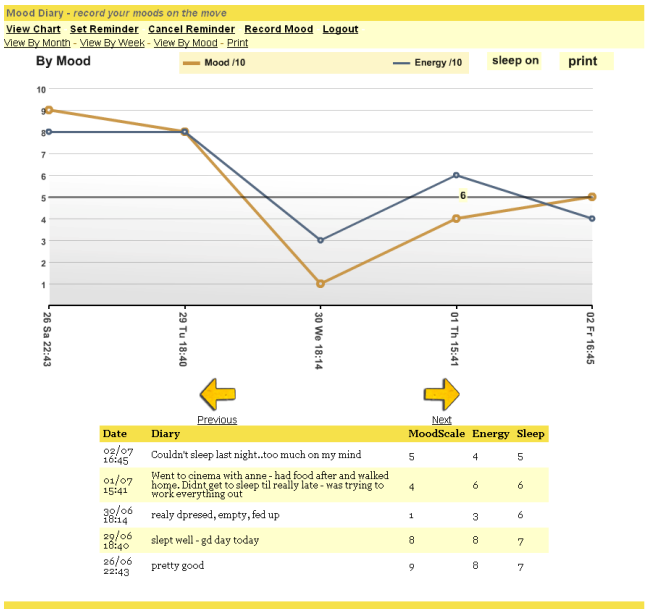

Figure 2 Online screenshots

Second Peer User Trial

The second peer trial was a 2 week field study with 3 inner-city schools [18]. An ethical review of the study and of the application was carried out by the Mater Hospital ethics review board. A non-clinical sample of 73 self-selecting students took part in the study with parental permission. Participants' ages ranged from 13 to 17 (*mean*=14.87 sd=1.14) and were mostly female (86.3%). 52 students (71%) were given paper-based charts and 21 students (29%) had the mood diary loaded onto their phones. They

were asked to use the diaries in their everyday lives and to record one entry per day over two weeks. There was no contact with researchers during this period. 17 mobile diaries and 18 paper diaries (of which 16 were completed) were recovered at the end of the two weeks, along with 70 questionnaires. No financial incentive was given.

Adherence: The main hypothesis of the study was that adherence would be higher in the mobile phone group than the paper group. All mobile diary entries were automatically time stamped. Adherence was judged as completing at least one entry per day over a two week period, and was significantly higher in the mobile group (Mann-Whitney-Wilcoxon, one-tailed, n_1=17, n_2=16, U=85, p = 0.034). The mean number of diary entries for participants was 8.12 in the mobile group and 5.44 in the paper group. A major weakness of the paper diary is the difficulty in assessing the validity of data; one teacher reported that several participants copied their entries before they were collected.

Ease of use: Although no technical training sessions or technical support was provided, participants found the mobile diary easy to use (mean =1.63, sd=.761 where 1= very easy and 5=very difficult).

Privacy: For this study there was no password protection on the mobile diary. While completing a mood entry, 18 phone participants (95%) felt they had sufficient privacy and 1 did not (5%), commenting that his brother would ask him what he was doing. 7 of the participants who used the paper chart felt that they had insufficient privacy.

CLINICAL EVALUATION OF *MMD*

Methodology

MMD was made available to a number of clinics in Ireland. Participants were asked to use *MMD* for a minimum of 2 sessions. This allowed for an initial session to introduce the tool and a second session to view and discuss collected moods. Clients were asked to record a mood entry once a day. Participation was based on client self-selection, with written client and parental consent. Where necessary, clients were reimbursed for credit used (1 client). No other financial incentive was provided. Client data was stored on a single secure server, and non-identifying summary statistics on duration of use, adherence, completion, and correlation between reminders and mood recording events were extracted. Questionnaires were provided for therapists and clients, although it was not always possible to collect complete records. The client questionnaires were administered by therapists. These questionnaires were supplemented by interviews with therapists.

Participants

MMD was used by 3 therapists with a total of 9 clients (mean age = 13.78 sd= 2.63), 3 of whom were female, and one parent, across a range of issues including depression, mood disorders, self-harm and anger management (**Table 1**). None of the therapists had participated in the design or previous stages of the evaluation. All clients were attending public mental health clinics. This includes one client (C9) who used a modified version of *MMD*, an Anger diary.

Client	Age	Principal Disorder	Therapist
C1	13	Suicide Risk	T1
C1a	Adult	N/A	T1
C2	12	Mood Problem	T1
C3	16	Self-Harm	T1
C4	10	Mood Disorder	T1
C5	10	Anger Management	T1
C6	15	Sleep Disorder	T3
C7	16	Depression	T1
C8	15	Social Anxiety	T1
C9	17	Autism/Anger Mgmt	T2

Table 1 Profile of participants

Results

An overview of the results by user is presented in Table 2. Every client who used *MMD* made several entries. Using a daily mood charting protocol (excluding C9), the mean adherence rate across all participants was 65%. More than one entry may be made in a day, but this is not factored into adherence which is calculated based on 1 entry a day. All clients used *MMD* for the minimum of two sessions, with 8 out of the 9 clients using it for longer. In total *MMD* was used for 1010 days, the longest period of use was 326 days, and the shortest was 7 days. In total 526 mood entries were made. Clinical evaluations took 2 years to complete.

client	days	entries	adherence	completeness	diary
C1	130	85	62%	100%	85
C1A	77	69	86%	87%	9
C2	25	25	80%	72%	20
C3	119	25	21%	100%	23
C4	237	60	23%	99%	47
C5	7	7	100%	71%	0
C6	20	15	75%	95%	2
C7	69	64	93%	91%	54
C8	326	166	50%	91%	165
C9	20	10	n/a	n/a	n/a
Mean	103.0	52.6	65.56%	89.56%	45.0
SD	105.2	48.5	28.95%	11.18%	52.9

Table 2 Mood Diary clinical pilot results

All 3 therapists provided questionnaire and interview feedback. They reported that *MMD* was helpful to the intervention, that clients found it interesting, and that they found it easy to use. They all expressed the opinion that the mobile phone was better than current paper materials for recording moods.

Adherence

Both the school and clinical studies provided evidence that high adherence could be reached using *MMD* over a sustained period. The mean adherence rate for the clinical pilot, 65% was similar to the adherence rate from the school-based study (58%). In the clinical pilot, even relatively low adherence rates for some clients of between 21-23% were higher than expected adherence for paper charts and over long periods. This level of adherence would indicate that *MMD* provided a convenient and engaging method for self-recording of mood. Many clients used the diary for much longer than originally requested (i.e. 2 sessions), suggesting that this type of intervention may be suitable for long term use. Figure 3 shows the patterns of use: a vertical bar indicates a day where an entry is made.

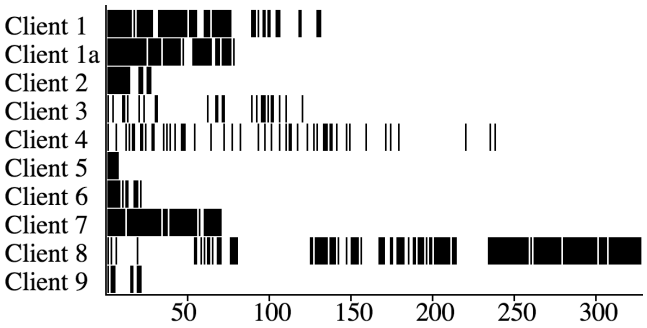

Figure 3 – Usage over time (in days)

Completeness

For each diary entry, a client can record a value for Mood, Energy and Sleep. However, a client could avoid making an entry by pressing 'Next' and skip to the following screen. *MMD* records whether clients initialize entries or simply skip to the next screen. This completeness statistic reflects the percentage of valid recordings a client made in relation to the amount of recordings they could have possibly made. For example, client 1 has a 100% completeness percentage because he made 255 active entries out of a possible 255 values; client 2 had 72% completeness, initialising 54 out of a possible 75 values. Overall, the mean completeness rate was 89% (sd= 11.1%). It indicates that the amount of detail requested was at the right level (taking the right amount of time) for clients.

Engagement

The adherence rate indicates a positive level of client engagement between sessions. It is more difficult to measure the engagement in a session and for that we have relied on feedback from therapists. Therapists felt that the use of mobile technology and computer printouts helped to engage the clients in therapeutic tasks and opened up conversations. Mobile phones were important to all of the young people. One therapist (T1) commented that introducing a mobile phone with his client was enough to break barriers down: *"I'm 56 – and appear old to most clients – for me to have something that they are comfortable with (mobile phones) opened up the conversation –they are comfortable talking about their mobile phones - they do it with peers. Clients found it very engaging."* (interview)

It may have helped relax clients by using a medium in which they have a strong interest and with which they are often more comfortable than therapists. The client using the anger diary found it particularly helpful because he could go somewhere quiet in the house to record an entry.

Case Studies

One means for overcoming limitations of access within clinical settings is to have the therapists capture a rich description of use through case studies. The case study method is often used in psychotherapy [20], and was suitable for use within the clinical pilot. We present here some segments of these case studies. Identifying characteristics such as names have been changed to preserve the anonymity of the individuals.

(1) Philip (C4)

'Philip' was a ten year old boy referred by his GP to the clinic as he had reported wishing he was dead and presented with low mood and excessive tearfulness. An initial psychiatric assessment diagnosed Philip as having a diagnosis of depression secondary to social isolation.

The intervention focussed on Philip's low mood and overly sensitive reactions to events and perceived events. While Philip was open and chatty on practical subjects he was more reticent when addressing his low moods. He engaged easily with *MMD*. He was specifically motivated by text entries and by the confidentiality offered through the password protection. A notable benefit of *MMD* was the development of his understanding through the use of the feedback graphs as he began to connect the antecedent events to his fluctuating moods. For example, on one occasion he could not explain a significant drop in his mood on the graph. Following exploration he was able to recall how his mood had been triggered by his perception that he had not done well in a competitive event.

Over a 237 day period, Philip made 60 entries; a 23% adherence rate. 78% of his entries included text entries. Despite being very articulate, most of these entries were very short, for example 'Publically humiliated' and 'Good but still a bit sick'. Philip recorded a higher level of text comments about feeling physically sick than the therapists had been previously aware of. On the feedback questionnaire both Philip and his parents concurred that

MMD was "Very Helpful" (on a five element scale from "Very Helpful to "Very Unhelpful").

(2) Barry (C8)

'Barry' was a fifteen year old boy who was re-referred by his GP with depression, social anxiety and school refusal. His previous referral had included a period of in-patient hospitalization, assessment by psychiatry and psychology, individual Cognitive-Behavioural Therapy (CBT), Family Therapy and anti-depressant medication. He had responded well and returned to school. Historically he found it difficult to comply with individual therapeutic tasks. Due to his poor adherence and given his particular interest in new technology it was decided to use *MMD*.

At the first session the client presented as "hopeless", he explained that he had received all the different types of therapy and they had not worked. The therapist outlined the benefits of CBT, however the client explained this had been done before. The client was familiar with the overall CBT approach from his previous therapy. When *MMD* was introduced the client was enthused on two fronts: firstly the difference in mode of recording from his previous pen and paper experience, and secondly the fact that he could use his mobile phone and would receive computer printouts. Barry was concerned about others seeing his paper recordings and stated that he felt more secure using the mobile phone application with a password.

Technical difficulties were initially encountered in uploading responses to the server. Consequently he was frustrated for several weeks with the system. Once the technology was established, his adherence was less frequent for several months. However, his text responses became an extremely detailed 'journaling' process whereby he described his innermost thoughts and moods contemporaneously. At a later stage he changed handsets. While waiting for his new handset to be registered with the system, he started reading his diary entries out from his phone's screen. Even when the new handset was registered and his moods were available online, he maintained a preference to read out his entries. The therapist interpreted this as increasing his sense of ownership of the therapeutic process. This mechanism was useful as he raised issues that were embarrassing for him first through the texts that subsequently could be shared in therapy.

After this period, his adherence increased. Importantly at this stage by using the printout graphs the client stated that he developed a better understanding of how certain events and thoughts were affecting the fluctuations in his mood. Barry recorded 166 entries over 326 days, a 50% adherence rate. Every entry included a detailed text entry.

(3) Beth (C1)

'Beth' was a thirteen year girl living with her single mother and younger sibling, referred by her GP. She had regular access to her father, but following a major disagreement with him she had not seen him for several months. Subsequently her mood had deteriorated, she had become irritable and there were thoughts of self-harm and suicidal ideation. Beth was seen by a psychiatrist for a mental health assessment over a number of sessions and she was commenced on anti-depressant medication. As part of the psychiatric mental health assessment Beth was requested to recall her mood, energy level and sleep each session for the previous week. On occasions she found it hard to recall specific details, which was relevant for monitoring risk factors and the efficacy of medication. MMD was introduced to assist Beth's recall. She recorded her first entry in the clinic.

Before three-way meetings with the psychiatrist, the therapist and the client would go to the computer room, login to the website and print out the past week's chart. In addition to the standard mental health assessment the psychiatrist used the graphs to monitor/assess the risk factors and prescribe medication accordingly. In clinical team meetings, these chart printouts were used to inform case discussions. At one point hospitalisation was considered due to the level of risk.

This client was struggling very much with her condition during the course of treatment and her mother indicated that their relationship was strained at times. At this stage, it appeared that there was a strong correlation between both the mother's and young person's mood. To explore this hypothesis the mother also agreed to maintain a diary. By putting their two print-outs together the mother, child and therapists were able to see that, at certain times, there was a strong connection between their moods. This led to productive conversations in therapy.

Beth recorded 85 entries over 130 days (62% adherence). She made active responses for all of her entries. Her mother, who began using the mood diary a week after Beth, recorded 69 mood entries over 75 days (86% adherence). She opened the diary 18 times without recording a mood, which may indicate that she was looking at her past moods. She made 9 diary entries – usually when her daughter was in bad form. Beth and her mother both used SMS reminders. The therapist (T1) felt that the SMS reminder was very helpful to Beth, particularly because the same device was used to remind the client and to record moods.

DISCUSSION

We present here a qualitative analysis of the clinical trial and case studies, supplemented with therapist feedback provided via questionnaire and explored further in interviews following the trial.

Evaluation Approach

The combination of therapist feedback and peer-user evaluations provided important information prior to clinical use. Therapists took part in evaluations at various stages to provide feedback on suitability for their working practice

and their clients, the clinical content and to help identify protocols for clinical use. Although some issues will only be discovered in a real therapeutic context, using peer users at earlier stages in the evaluation can help remedy other issues (usability, design elements, protocols) that cannot reasonably be left to clinical settings to identify.

Therapist Adoption

The greatest barrier to the uptake of MMD was therapists' lack of technical confidence. In some cases, seeing colleagues use the system provided an incentive for others to use it. This was the case with one therapist (T2) who went on to participate in the design and evaluation of the Anger Diary. Carter and Mankoff have suggested using "local champions" to promote a system with reluctant people; individuals with fixed views of technology or little experience with novel technologies [36]. Therapists would likely benefit from the support and encourage from a therapist familiar with the system: "*perhaps therapists need a buddy system (a therapist on each team with a strong competence in technology).*" (T1 - interview)

Adherence and Engagement

The levels of adherence observed in the clinical pilot were high when compared to adherence for paper diaries. Although we can see that the rate varied considerably between clients. The case studies shed a little further light on this; the fact that the level of adherence may change over the course of time is worth considering. Barry's case also reveals that technology may be used as a way to re-engage with clients who have previously received treatment. In such cases even novelty value is helpful when it may lead to better engagement. As might be expected, SMS reminders were found to be useful by several of the clients in the clinical pilot.

Use of the Text Diary Field

The case studies revealed that the diary field was used in different ways by different users. Philip recorded brief entries, whereas Barry used it as the basis for a much more detailed journaling activity. Beth's mother used the text field when having particular difficulty with her daughter. Through the text field, Philip's therapist learned about his sickness, which had previously not been identified.

A therapist comment in the postal survey suggested that the potential of technology in sessions was as a *"tool to focus child on particular areas of discussion without it becoming too threatening"*. The way in which Barry used the text entries to broach embarrassing topics with the therapist illustrates another way in which the diary can be used as the basis for therapeutic conversations, beyond connecting events to moods. This indicates the value of identifying new methods to support indirect disclosure in session.

Importance and Potential of Graph

The online graph, and the ability to print it out, was central to the success of *MMD* in clinical sessions. T1 often printed the graph with the client at the very beginning of the session: *"the printouts were very helpful…..the graph was really useful, it saved the therapist time entering it"* (questionnaire). He encouraged clients to share the printouts with parents and with collaborating psychiatrists. With the client's permission, these printouts were used in team meetings when discussing client cases.

The paper printouts provided clients with tangible records of their moods. Most clients were comfortable showing their graph printouts to their parents. In some cases, they provided a stepping stone to discussing the client's feelings with parents and helped parents see what was going on emotionally with their children. T1 taped all of one client's printed graphs together as a record of his mood history. This indicates that the desktop *MMD* could more explicitly support analysis. T1's comments support this:

"With current client we could see how he had improved overall from April to May. It would be useful to compare the means from each month to show that he was improving a bit." (interview)

Several clients and parents also suggested that they would have found weekly and monthly reports based on the graphed data useful. It was suggested by one therapist to provide basic graphs on the mobile phone. In situations where the client did not have mobile phone credit and consequently could not send mood information to the online system, it would be possible to use the handset as a shared device. Additionally, it would provide the client with an overview of their status between sessions. This feature was added to the mobile *MMD* during the clinical pilot, although sufficient feedback has not been obtained to come to any conclusions on its use. Providing feedback raises the question about what information to present and what to do if the client's condition is deteriorating. Some therapists were uncomfortable with clients reviewing their progress on their own. For this reason, we provided a choice between a diary with and without a chart.

Perceived Privacy and Security

As expected, privacy, and the password mechanism were important to clients in the clinical pilot. A protocol whereby the client held login details for the system may also have helped in this regard. While the mobile phone seemed to provide sufficient privacy for clinical end-users, there were some issues at the early stages of the clinical pilot. Several therapists reported that some clients had a problem with the 'Mood Diary' title of *MMD* tool on their phone and in fewer cases with the emoticon icon used to represent it. A therapist who did not participate in the trial reported that: *"one 16 yr old would not install diary because her friends sometimes use her phone and she is afraid they will see an application named 'mood diary'."* (pers. comm.). Two other clients declined to use *MMD*

because they were concerned about confidentiality on the phones: *"Young people hand each other their phones – clients were concerned they would notice something" (pers. comm.).* The application was accordingly modified to remove the icon and to shorten the title to 'MD', which was meaningful to clients but meaningless to peers. Once this change was made, no further issues were reported.

Supporting Recall

In the cases of both Philip and Beth, we gain some insight into how the system was used to support recall of events and mood. For Philip, it was a case where a significant drop in mood was explored with the therapist until the relevant event was recalled, whereas for Beth it concerned a more general difficulty in recalling details of her mood, sleep and energy. Some medication may also have effects on the recall of users, in which case such support may be very useful. With increasingly powerful and sensor enabled phones becoming available richer data logging may be possible to facilitate recall.

Need for Flexible Tools

Mamykina et al. have previously argued for flexibility in data capturing systems in order to allow users to repurpose systems to their own needs [17]. For some clients, the mobile phone may not be the most suitable medium. In the survey described earlier, a small percentage of young people preferred a paper chart to a mobile one. One aspect of the clinical pilot involved following up with therapists whose clients declined to use *MMD*. One client said *"he did not like using his phone when he felt down" (pers. comm.).* The therapist put forward the possibility that *MMD* might become ineffective once mood reached extremely low levels. The clinical pilot suggests that this is not the case: the mood of several clients dropped to very low levels, yet they continued to chart. However, it seems that for certain clients the strengths of the phone such as its social status and communication features might be problematic due to the nature of their illness. Another client did not want her mobile phone *"connected"* to therapy. A third client did not have mobile coverage in her area, but was able to use the desktop *MMD*. This emphasizes the need to provide multiple entry points for clients to engage in therapeutic activities. Mood charting systems should provide clients with a choice of a paper, mobile phone and desktop mood chart.

LIMITATIONS

This research is exploratory. We have sought to identify broad issues in an area where there is little previous work and much need. However, there are clear limitations to this work. The clinical trial was based on a small heterogeneous sample with limited feedback from young people.

FUTURE WORK

The technological capability of mobile phones has changed markedly in the last few years, and many of the practical limitations of the previous generation of devices have been removed, making larger scale testing and dissemination feasible. As illustrated by the Anger Diary variant of the system, an adaptable system, which allows therapists and clients to tailor charts to their own needs, could be a valuable tool. We are currently developing such a system.

CONCLUSION

This paper illustrates an approach to development and evaluation used to overcome some of the difficulties of designing for the mental health care domain, and has resulted in an effective mobile tool to support clinical interventions. While the study is limited in scale and format, it has a degree of ecological validity. It has been evaluated in a real clinical context, with young people suffering from a range of serious mental illnesses, and using their personal mobile phones (which would need to be the case for any large scale deployment).

The research has allowed an initial exploration of the general benefits, feasibility and limitations of using the mobile phone for therapeutic activities with an adolescent audience. The clinical pilot in particular has shed light on issues of relevance to other HCI research working on diary systems, personal healthcare systems, as well as mental health systems. The way in which the diary can be used to support recall, broach difficult topics, and be used for different purposes by different people are important to consider. The paper printouts were found to be highly important in supporting conversations, not just between client and therapist, but also with parents and a wider multi-disciplinary healthcare team. The continued use of the system by clients over a long period of time suggests that such applications may be appropriate for the management of specific mental health problems such as bi-polar disorder which can require life-long monitoring of mood and other factors.

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